Rapport de recherche

The incidence of Payroll Taxes in Quebec and Ontario on wages: evidence from collective agreements for 1985-2007.

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Abstract

This study constructs an original data set of the population of all collective agreements which counted more than 500 employees and were signed in Quebec or Ontario during the period of 1985-2007, to measure the incidence of an increase in payroll tax. Two alternative models of the incidence of an increase in payroll tax were used: one model separates the general from specific tax and express the tax variables in their level form, while the second model separates the general from specific tax but express the tax variables in rate of change. We use the Davidson-MacKinnon test to see which model is a better specification of the relations in the data and we conclude that the tax variables should be expressed in level form. The results of this model show that that after one year, a one percentage point increase in the general payroll tax reduces wages growth by 1/2 of a percentage point in Quebec and 1/4 of a point in Ontario. The measured incidence for the general tax suggests the existence of a trade off between private earnings and social benefits financed with payroll taxes.

Résumé

Cette étude construit une base de données originale de la population des conventions collectives comptant plus de 500 employés et qui furent signées au Québec ou en Ontario durant la période de 1985-2007, afin de mesurer l'effet d'une augmentation de taxe sur la masse salariale. Deux modèles ont été utilisés pour mesurer l'effet d'une augmentation de taxe sur la masse salariale : le premier modèle sépare les taxes générales et les taxes spécifiques en incorporant les taxes en niveau dans le modèle, tandis que le second modèle sépare les taxes générales et les taxes spécifiques en incorporant les taxes en taux de variation en pourcentage dans le modèle. Nous utilisons le test de Davidson-MacKinnon pour déterminer lequel des deux modèles est une meilleure spécification des relations dans les données, et nous concluons que les variables de taxation devraient être incorporées en niveau dans le modèle. Les résultats de ce modèle indiquent qu'après un an, une augmentation d'un point de pourcentage des taxes générales sur la masse salariale fait diminuer la croissance des salaires de 1/2 point de pourcentage au Québec et 1/4 de point de pourcentage en Ontario. L'effet mesuré des taxes générales sur la masse salariale suggère l'existence d'un arbitrage entre les revenus privés et les bénéfices sociaux qui sont financés par les taxes sur la masse salariale.

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Introduction

In the OECD member countries there is a trend toward increase reliance on payroll taxes to finance social security programs; the unweighted average of payroll taxes as percentage of GDP among OECD countries was 4.9% in 1965[1] compared to 9.6% in 2006[2]. In Canada the average of payroll taxes as percentage of GDP was 1.4% in 1965[3] compared to 4.9 in 2006[4]. This raise some concerns about the actual impact of payroll taxes on wages and employment. It is known that payroll taxes increase the indirect costs of labour, but economists are still debating the reaction of employers to such taxes. It is important to understand the impact that payroll taxes have on employment because governments around the world could be attracted by the idea of financing their safety nets and other social programs with payroll taxes without knowing if this leads because of higher labour costs to fewer jobs or to lower wages with no negative impact on employment.

The purpose of this study is to measure the incidence of payroll taxes on wages in order to further our understanding of this type of tax. This study constructs an original data set of the population of all collective agreements covering 500 employees or more that were signed in Quebec or Ontario during the 1985-2007 period. This data set has cross section and time series dimensions, which gives more variation in the payroll tax. Since the data set contains information on the population rather than a sample of the population, this study avoids random sample problems. Moreover the fact that the data follows different collective agreements explains the choice of the pooled regression method. This paper uses pooled regression to estimate two different models of wage determination equation, one model that distinguish general from firm-specific payroll tax and uses an help-wanted index to account for the variation in the labour demand, while the other model distinguish general from firm-specific payroll tax and uses the unemployment rate to account for the variation in the labour demand. The first wage

[1] Lin, Z., Picot, G. And Beach, C. (1996).
[2] Statistiques des recettes publiques des pays membres de l'OCDE 1965-2007, OCDE, Paris 2008, Tables 14 and 39.
[3] Lin, Z., Picot, G. And Beach, C. (1996).
[4] Statistiques des recettes publiques des pays membres de l'OCDE 1965-2007, OCDE, Paris 2008, Tables 14 and 39.

equation regress the negotiated growth in base wage on general payroll tax, firm-specific payroll tax, the average annualized inflation two quarters before the collective agreement, a dichotomous variable to indicate the presence of a cost of living agreement in the collective agreement, an help-wanted index which proxy the unmet demand of labour and eighteen dichotomous variables to indicate the nineteen industries. The second wage equation uses the same control variables but uses the average unemployment rate observed two quarter before the collective agreement instead of the help-wanted index.

This study is organized in three main sections. Section 1 explains the problems that arise when one tries to measure the incidence of a payroll tax and reviews the relevant literature on the incidence of payroll taxation. Section 2 presents the institutional background of payroll taxation in Canada, the data used in the study and the model. Section 3 analyzes the results of the estimations.

Section 1. Literature review and the adopted model.

We begin with the presentation of the problem setting, which explains the problems that arise when one tries to measure the incidence of a payroll tax.

1.1 The Problem Setting

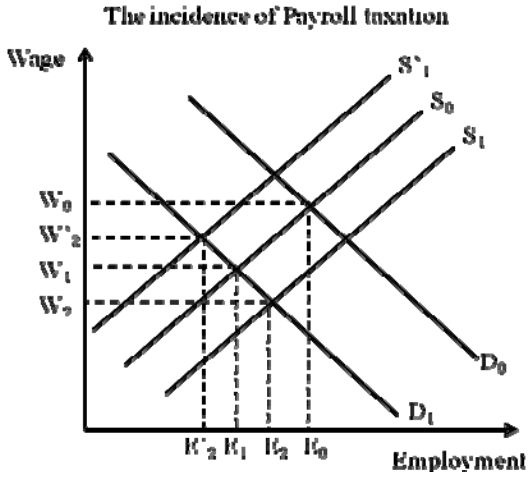
The marginal productivity theory is a sufficient but not necessary condition to show that employers' payroll taxes are borne by workers. This classical view was stated by Harry G. Brown in 1924.[5] In particular he argued that: "rationality and competition lead employers to hire workers until the point is reached where the wage is just barely recouped by the marginal value product and that if a tax is imposed on the employers in proportion to the labour hired, the marginal worker will no longer be hired unless he accepts a reduced wage which is lower by the amount of the tax".[6] If we make the assumption that wage are set under the marginal productivity theory, we can maximise the profit of a representative firm to derive the equilibrium wage after the payroll tax increase. Lets Max $Pf(L,K) – (wL + rK + tL)$, where P is the product price, f(L,K) is the production function, w is the workers wage, r is the cost of capital and t is the employer payroll tax. The first order condition is $Pf'_L – w – t = 0$, if we rearrange this condition to isolate the workers wage we have $w = Pf'_L – t$, which shows that under marginal productivity theory, the tax is fully borne by the workers.

The assumption of cost minimization is a less restrictive assumption than the one used above that can be used to derive the impact of an increase in the employer payroll tax.[7] To satisfy this assumption, the ratio of marginal value product to factor cost must be equal, which means that if an employer payroll tax is added to the cost of labour, the employer will have to recoup the amount of the tax by either lowering wages, lowering employment or increasing its product price.

[5] Brittain (1971, 113).
[6] Brittain (1971, 113).
[7] Brittain (1971, 114).

Another way to understand the effects of payroll taxes is to use a graphical exposition of the potential effects. Figure 1 shows a graphical exposition of the incidence of payroll tax. [8]

Fig 1



The S_0 slope represents the supply of labour by workers and the D_0 slope represents the demand for labour by employers without taxation. When a payroll tax is levied on firms, the indirect costs of labour increase and the demand for labour by firms shift to D_1, which imply that the equilibrium wage falls from W_0 to W_1 and the employment falls from E_0 to E_1. The difference between E_0 and E_1 is what economists call the disemployment effect of a payroll tax. The importance of this disemployment effect depends on the elasticity of demand and supply of labour.

On the other hand, in Gruber (1997) it was argued that it is important to add the tax benefit linkage into the model in order to have a complete graphical exposition of the effect of a payroll tax. The argument is the following, "In the presence of such a linkage, workers are receiving higher net compensation than in the pure tax model, since the tax is buying them some benefits. Workers are therefore more willing to work harder for a given amount of money wage". [9] The

[8] Figure 1 is based on the graphical exposition showed in Gruber (1997, S75).
[9] Gruber (1997, S76).

presence of tax benefit linkage can be modeled in figure 1 as a shift of the supply of labour from S_0 to S_1 which further lower the wage to W_2 and also increase employment from E_1 to E_2. Thus the presence of tax benefit linkage reduces the disemployment effect of a payroll tax increase. However adding the benefit linkage in an empirical model is something that has never been done. This is due to the complexity of measuring the extent to which the benefits bought by the payroll tax are valued by the workers.[10] The benefit linkage is not the only parameter that influences the efficiency cost of an increase in payroll tax in terms of jobs lost. In Gruber (1997) the author uses a mathematical derivation of the simple model that we used for our graphical exposition to show that full shifting can have three main distinct causes, an elastic demand, an inelastic supply or a full tax benefit linkage.[11] Moreover, in Vaillancourt and Marceau (1990) it was also argued that the type of payroll tax either general or firm-specific influences the incidence of payroll taxes.[12] The firm-specific taxes vary among different employers according to the level of risk of their industry and their firm. If we make the assumption of no benefit linkage, then an increase in firm-specific payroll tax lowers the demand of labour, shifting D_0 to D_1. But the need of a risk premium to compensate the workers for working in a riskier work environment moves the labour supply curve from S_0 to S'_1. Depending on the relative magnitude of the two effects, the equilibrium price W'_2 can be lower, equal or above W_0. Thus, the theoretical literature on the subject has identified four main parameters which highly influence the incidence of a payroll tax; an elastic demand of labour, an inelastic supply of labour, a full tax benefit linkage and the type of payroll tax, either general or firm specific.

The simple graphical model that we used to illustrate the incidence of payroll taxation allowed us to highlight the main parameters which determine the magnitude of the backward shifting of an increase of payroll tax through lower wages or lower employment. However it is important to keep in mind that, as argued by Gruber (1997), this paper estimates a reduced form model which implies that if the estimation shows full shifting the model will not give any information about the structural cause of the measured incidence. Still, assessing correctly the actual incidence of payroll taxation would be a step forward in the direction of better economic policies.

[10] See Appendix 6 for an analysis of the impact of an increase in payroll tax which distinguishes general tax with benefits from general tax without benefits.
[11] Gruber (1997, S77).
[12] Vaillancourt and Marceau (1990, 181).

1.2 Brittain (1971)

The first econometric study on payroll taxation that we will review is by Brittain (1971). In that paper, the author tries to isolate quantitatively the impact of employer payroll taxes on factor shares in the long run. In order to measure the impact of payroll taxes, the author builds on the relationship between the compensation and productivity of labour, which has been empirically observed, and can be mathematically derived under certain assumptions, more precisely the specification of a production function.[13] Based on these assumptions, the author conducts an inter-country analysis, which takes advantage of the wide variation in tax rates among the different countries.

This study uses the ordinary least square method (OLS) to estimate a cross-sectional regression of aggregative data among different countries. The author argues that this approach gives the long-run incidence of a payroll tax on wages. The data on wages and employment come from manufacturing censuses for 1958, but the author also adds any other census in the period of 1957 to 1959. The data set contains 64 countries and up to 12 different industries which gives a total of 407 observations. The effective tax rates were estimated from the statutory rates, which are set in each country by the government.

This research uses a statistical model which is a variation of the estimating equation that emerges from the constant elasticity of substitution production function (CES). The author uses this statistical model to regress the log of the value-added per labour input in men-years on the variables wage and minus log of one and the tax rate. In order to avoid dependence on any assumption on the particular direction of this equation, the equations are fitted both ways.

The author finds an incidence of -1.14 to -1.60 depending the equation used, namely when the dependent variable expressed as the log of wage, as the log of productivity, as the wage or the productivity. These coefficients are not significantly different from a coefficient of unity. Moreover, the author also estimates a pooled regression of all the industries which gives an incidence of -1.18. The main conclusion of the author is that for a given level of productivity in a

[13] Brittain (1971, 111).

country, an increase in payroll taxes lowers mean nominal wages by the exact amount of the tax. Thus this study finds evidence of backward shifting of the payroll tax through lower wages for workers. This suggests that employers face a trade off between the employer payroll taxes and private compensation for their workers.

1.3 Holmlund (1983)

The next important study is Holmlund (1983). This study adopts a short term approach, tax lagged 1 year, to analyse the postwar incidence of the payroll tax increase on wages in Sweden. This study uses a data set in which wage rates refer to average hourly earnings for adult blue-collar male who work in mining and manufacturing. The author constructs a new aggregate wage measure adjusted for inter-industry employment shifts and excluding overtime premiums. Moreover this study covers the period of 1949 to 1979.

The author uses OLS and a two-stages least squares (2SLS) time series regression to measure the incidence of payroll taxes on wages. In particular, the author regresses in first difference the log of wages on log of 1 plus the payroll tax rate, log of 1 minus the average income tax rate for workers in mining and manufacturing, log index of volume of production in mining and manufacturing divided by the output trend, log of the current and lagged one year producer price index for industrial products (PPI and PPI_{-1}) and the log of the consumer price index (CPI).

According to the author, given the assumption of the absence of money illusion, there are good a priori reasons for allowing both output and consumer prices to enter the wage equation. The author argues that price of a product affects the wage of a worker even after we take account for the rate of change of the CPI. On the other hand, including both the product price and the CPI in the wage setting equation may create causality problems due to the possibility that the product price may determine the wage or that wage may determine the product price. Thus the author also estimates a 2SLS regression. In the 2SLS regression, the current PPI was instrumented by the exogenous variables of the wage equation, the change in indirect taxes, import prices, labour productivity, the money supply and change in the CPI lagged one year.

This study measures an incidence of payroll taxation of -0.492 for the simple OLS regression and -0.462 for the 2SLS regression. Thus, the findings suggest that only a fraction of payroll tax increase were directly shifted back to workers as lower wages. However, these results rely on a

time span of 1 year which limits the measured incidence to the short-term effects of a payroll tax increase.

As argued by the author, it is possible that the long-term incidence also falls on labour, despite the fact that the short-run analysis suggests partial backward shifting to workers as lower wages. Moreover, these results also suggest the presence of a significant incidence on employment in the short-run.

1.4 Vaillancourt and Marceau (1990)

The third study reviewed here is that of Vaillancourt and Marceau (1990) which draws on Marceau (1988)[14]. This study uses Canadian data to measure the incidence of general and specific payroll taxes. This study shows the importance of distinguishing general from specific payroll taxes, because these two types of taxes do not have the same effect on wages. Previous studies did not distinguish among these taxes, which one explanation for the wide range of estimate found in the previous literature. For reasons that we will explain in the next section, the model that was used in Vaillancourt and Marceau (1990) will be the model used in the paper.

The study uses panel data for large (500 employees and over) individual collective agreements in Quebec as collected by Labour Canada during the period of 1975 to 1984. It is important to acknowledge the fact that the data does not necessarily follow the same collective agreements from one period to the other. The authors estimate a wage determination equation with the (OLS) pooled regression method. More precisely the authors regress the negotiated rate of growth in base wage on the rate of change of sum of the general payroll taxes and specific payroll taxes, the average vacancy rates, the rate of change of the consumer price index (CPI), a dichotomous variable which indicates the presence of a cost of living clause (COLA) in the collective agreement and several dichotomous variables for industries and a dichotomous variable to capture the effect of wage controls during that period.

The variable vacancy is a proxy for the unmet demand of labour adjusted for the change in the size of the labour force. The variable COLA indicates the presence of indexation clauses in the

[14] Marceau, N. (1988), Incidence à court terme sur les salaires de la croissance des taxes sur la masse salariale, M. Sc. (Université de Montréal, Montréal, Québec).

collective agreement. The results of this research show that general taxes have a negative impact on the negotiated rate of growth of base wages, while the specific taxes have a positive impact.

The paper finds that the rate of change in the sum of the general payroll taxes has an impact of -0.247 or -0.0389 if the square of CPI and vacancies are used, while the rate of change in the firm-specific payroll tax has an impact of 0.0266 or 0.0260. The authors also tried to aggregate the two types of taxes, but the payroll tax coefficients are not significant. The main conclusion of this paper is that previous research on payroll taxes arrived to a wide range of estimates which sometime seemed incompatible because they did not distinguish general from firm-specific payroll tax.

1.5 Gruber (1997)

A more recent paper on the incidence of payroll taxation is Gruber (1997). This study takes advantage of Chile's experience before and after the privatization of the social security system in 1981 which led to an important exogenous reduction in the payroll tax burden on Chilean firms, to estimate the impact of payroll taxation. In other words, the author uses a natural experiment in order to measure the incidence or payroll taxation in Chile. This study uses data from a survey of all Chilean manufacturing plants which counted more than ten employees over the period of 1979-1986. This data set contains information on total wages, employment, payroll taxes paid and a variable that indicates if a worker is a blue or a white collar worker. Moreover the author only uses the data for the years 1979, 1980, 1984 and 1985 in order to avoid the effects of the 1982 recession which he argues may not be captured by the time dummies.

The author creates payroll tax rates for each firm by dividing total tax payments by wages. The author also analyses the variation in the constructed tax rates to see if they reflect the true differences across firms in the underlying legislated costs of social insurance. The author estimates four different regressions to obtain the incidence of a increase in payroll tax on wages and he does the same for employment in order to see if the results of the wage equation are caused by a spurious relation between wages and payroll tax rates. The results of the basic difference pooled regression, in which the author regresses in first differences the dependant variable, either wages or employment, on the difference of the constructed tax rates, time dummies, dummy for workers group, finds that a 1 percentage point increase in payroll tax

reduces wages by 1.20 percentage points and has no significant effect on employment. The results for the difference-in-differences regression, which includes plant effects in the differenced regression finds that a 1 percentage point increase in payroll tax reduces wages by measures wages by 1,022 percentage points and has no significant effect on employment. The third regression is the basic differences regression where the difference of tax rates is instrumented by the other working class, the white collar had the difference of tax rates of the blue collar and vice versa. This regression finds that a 1 percentage point increase in payroll tax reduces wages by 1,412 and has no significant effect on employment. Finally, the author did a basic difference regression which uses area and industries as a grouping instrumental variable in order to correct the potential problem of spurious variation in the tax rate. This fourth regression estimated an incidence of -1,561 on wages and no significant effect on employment.

The main conclusion of this research is that privatisation of Chile social insurance system, which led to an unprecedented reduction of payroll tax rates on firms, increased the wages by the amount of the tax and had no effect on employment. This suggests that if downward rigidities are not too important, an increase in the payroll tax rate reduces wages by the exact amount of the tax which suggests full backward-shifting.

1.6 Kugler and Kugler (2008)

Another recent study on the incidence of payroll taxes is Kugler and Kugler (2008). This paper uses a panel of manufacturing plants from Colombia to estimate how the rise in payroll tax rates over the 1980s and 1990s affected the wage and the employment of the Colombian workers.

The author argues that the Colombian labour market is an interesting market to analyse the impact of payroll taxes, since payroll taxes in this country amount to approximately 40% of the payroll which is higher than European labour markets where taxes amount to 30% and North American labour markets were contributions are between 15% and 20%.[15] The study uses a balanced panel of plants in the formal sector from the Annual Survey of Manufacturers in Colombia over the period 1982-1996. The data set contains information on total contributions,

[15] Kugler and Kugler (2008, 3).

wages and employment. The authors constructed tax rates for each plant by dividing total contributions by the sum of all the wages.

The authors control for sector specific trends as well as plant-specific trends by adding dichotomous variables for sectors and plant effects. They regress the difference of total wages per employees on the difference of the constructed tax rates, a dichotomous variable for production jobs and years, sector effects and plant effects.

The results of this study without controlling for sector-specific effects suggest that a 1% increase in payroll tax rate reduces wages by 0,142% and employment by 0,273%. Controlling for sector specific trends gives larger effects on both wages and employment. In particular, the results suggest that a 1% increase in the payroll tax rate reduces wages by 0,187% and employment by 0,305%. Finally the results with plant-specific trends suggest that a 1% increase in the payroll tax rate reduces wages by 0,235% and employment by 0,384%. Thus the results of this study suggest that only one fifth of the increase in taxes was shifted to workers as lower wages, which imply partial backward shifting. The authors argue that this "less-than-full-shifting" could be explained by the weak linkages between benefits and taxes and the downward wage rigidities which characterise the Colombian labour market. This could explain why unlike Kugler and Kugler (2008), Gruber (1997) found full shifting when he used the fall in payroll tax rate that followed the privatisation of Chile's social insurance. This suggests the possibility that the incidence of an increase in payroll tax differs from the incidence of a decrease in payroll tax because of the downward wage rigidities that are present in most labour markets.

Table 1
Summary of the studies reviewed

Author(s) and year	Subject	Variables	Data	Estimation Method	Results
Brittain (1971)	Econometric study of the incidence of payroll taxation an inter-country apporch.	**Dependent variable:** 1) Value-added per labour input. 2) Wage. **Independent variables:** 1)Wage and -Log(1+taxe). 2) Value-added per labour input and -log(1+taxe). **Dichotomous variables:** Industries.	The data on wages and employment come from manufacturing censuses for 1958, while some additional observations came from the 1957 and 1959 census. The data set contains 407 observations on 64 countries. **Payroll taxes:** The effective tax rates were estimated from the statutory rates. The general and specific taxes were aggregated.	This study uses the ordinary least square method (OLS) to estimate a cross-sectional regression of aggregative data among different countries. This approach gives the long-run incidence of a payroll tax on wages.	Incidence of -1,14 to -1,60 which in not significantly different from a coefficient of unity. For a given level of productivity in a country, an increase in payroll taxes lowers mean wages for workers by the exact amount of the tax. **(This study finds full Shifing).**
Holmlund, B. (1983)	This study adopts a short term approach, time span of 1 year, to analyse the postwar incidence of the payroll taxes increase on wages in Sweden.	**Dependent variable:** 1) First difference of Log (wage). **Independent variables:** Log of 1 + the payroll tax rate , log of 1 minus the average income tax rate, log index of volume of production divided by the output trend, log of the current and lagged one year producer price index for industrial products (PPI and PPI-1) and the log of the consumer price index (CPI).	This study uses a data set in which wage rates refer to average hourly earnings for adult blue-collar male who work in mining and manufacturing. The author constructed a new aggregate wage measure adjusted for inter-industry employment shifts and excluding overtime premiums. The number of observations in the data set is not available in the paper. **Payroll taxes:** The general and specific taxes were aggregated. The statutory payroll tax rates were used.	1) OLS time series regression. 2)2SLS time series regression where the current producer price index (PPI) was instrumented.	This study measures an incidence of payroll taxation of -0.492 for the simple OLS regression and -0.462 for the 2SLS regression. Thus, the findings suggest that only a fraction of payroll tax increase were directly shifted back to workers as lower wages. **(This study finds partial Shifing).**
Vaillancourt and Marceau (1990)	This study uses Canadian panel data to measure the incidence of general and specific payroll taxes.	**Dependent variable:** The negotiated rate of growth of base wages. **Independent variables:** The rate of change of general payroll taxes and specific payroll taxes, the average vacancy rates, the rate of change in the consumer price index (CPI). **Dichotomous variables:** A a dichotomous variable which indicates the presence of cost of living agreement clause (COLA), dichotomous variables for industries and a dichotomous variable for wage controls.	The study uses panel data for large (500 employees and over) individual collective agreements in Quebec as collected by Labour Canada (1975-1984). The data set contains 780 observations on the collective agreements signed in Quebec during the period. **Payroll taxes:** UI, Q.P.P, CNT, HSF, CSST. The general and specific taxes were incorporated separetely in the model. They impute the average payroll tax rates based on the province and the sector of the business.	The authors estimate a wage determination equation for the province of Quebec with the (OLS) pooled regression method.	The general taxes had a negative impact on the negotiated rate of growth of base wages, while the specific taxes had a positive impact. Previous research on payroll taxes arrived to a wide range of estimates, which could be explain by the failure of the previous studies to distinguish general taxes from specific taxes. **(This study finds partial Shifing).**

Gruber (1997)	This study takes advantage of Chile's experience before and after the privatization of its social security system which led to an important exogenous reduction in the payroll tax burden on Chilean firms, to estimate the impact of payroll taxation.	**Dependent variable:** 1) First difference of Log (wage). 2) First difference of Log (employment). **Independent variables:** The difference of the constructed tax rates. **Dichotomous variables:** Time dummies and dummy for workers group.	Survey of all Chilean manufacturing plants which counted more than ten employees over the 1979-1986 period. This data set has information on total wages, employment and payroll taxes paid, information on blue and white collar workers. The data set contains 6066 observations on the wages of Chilean firms. **Payroll taxes:** The general and specific taxes were aggregated. They use firm-level data on total wage to construct the tax rates.	1) Basic difference pooled regression (OLS). 2) Basic difference pooled regression with plant effect (OLS). 3) Basic difference pooled regression with instrumental variable for group payroll taxe (IV). 4) Basic difference pooled regression with area and industries as a grouping of instrumental variables (IV).	Results Reg 1) -1,20 on wages and no effect on employment. Results Reg 2) -1,022 on wages and no effect on employment. Results Reg 3) -1,412 on wages and no effect on employment. Results Reg 4) -1,561 on wages and no effect on employment. The privatisation of Chile social insurance system which led in a reduction of payroll tax rates on firms increased the wages by the amount of the tax and had no effect on employment. **(This study finds full Shifing).**
Kugler and Kugler (2008)	This paper uses a panel of manufacturing plants from Colombia to estimate how the rise in payroll tax rates over the 1980s and 1990s affected wages and employment.	**Dependent variable:** The difference of total wages per employees. **Independent variables:** The constructed tax rates (total wages / employees), sector effects and plant effects. **Dichotomous variables:** Variable for production jobs and years.	The study uses a balanced panel of plants in the formal sector from the Annual Survey of Manufacturers in Colombia over the period 1982-1996. The data set contains information on total contributions, wages and employment. The data set contains 470 observations on the wages of Colombian firms. **Payroll taxes:** The general and specific taxes were aggregated. They use firm-level data on total wage to construct the tax rates.	This study uses the ordinary least square panel regression method (OLS) to estimate a balanced panel regression in first differance.	Without controlling for sector-specific effects suggest that a 1% increase in payroll tax rate reduces wages by 0,142% and employment by 0,273%. Controlling for sector specific trends gives larger effects on both wages and employment. The results suggest that a 1% increase in the payroll tax rate reduces wages by 0,187% and employment by 0,305%. With plant-specific trends result suggest that a 1% increase in the payroll tax rate reduces wages by 0,235% and employment by 0,384%. **(This study finds partial Shifing).**

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Section 2. Institutional background, data description and the model.

In this section the data used in the estimations will be described and summarized. Before we begin the presentation of the data set and the variables used in the model, we will examine the Canadian institutional background under which the federal government and provincial governments levy payroll taxes. This exercise will give us a better understanding of the rather complex structure under which payroll taxes are levied.

2.1 Institutional background.

In Canada there are seven different payroll taxes, namely the unemployment insurance or employment insurance (UI/EI), the Canada/Québec pension plan (CPP/QPP), the workers compensation (WC/CSST), the Health and education (HE/HSF), the labour standards (CNT) in Québec, the employer training tax and the Quebec parental insurance plan (QPIP). The UI and CPP are the two payroll taxes raised by the federal government, excepting the case of Quebec which is the only province where a different pension plan is administered by the government of Quebec; the Quebec pension plan. WC is raised by all provincial governments, a province specific HE is only raised in Quebec, Manitoba, Ontario and Newfoundland. These seven payroll taxes can be divided into general and firm-specific payroll taxes. In Vaillancourt and Marceau (1990), the authors provided appropriate definitions of these two types of payroll taxes and this is why we use the same definitions. [16]

The general payroll taxes are levied on employers at a uniform rate and do not depend on the behaviour of the employers. The UI, CPP, QPP, HE, CNT and QPIP are the payroll taxes that fall under this category. On the other hand, the firm-specific payroll taxes are not levied at uniform rate but vary between employers according to the behaviour of the employer or their industry. The WC/CSST and the employer training tax are the payroll taxes that fall into this category.

[16] Vaillancourt and Marceau (1990, 176).

Now that we have presented the payroll taxes and discussed the two labels under which they can be classified, we will briefly explain how the level of these payroll taxes are set and we will also explain the purpose for which they are collected.

Unemployment Insurance[17]

The unemployment insurance system is self-financing but sometime generates a surplus. The premium rate is set each year using a statutory rate as a benchmark. Both employer and employee UI premiums are charged on all earnings up to a ceiling. The employers pay 1.4 times the rate of the employees. This tax finances the Canadian unemployment insurance program which provides temporary financial assistance for unemployed Canadians.

Canada/Quebec Pension plan[18]

The Canada pension plan contribution rate is based on an actuarial review carried out every five years by the Office of the Superintendent of Financial Institutions. The Quebec pension plan (QPP) contribution rate is based on the actuarial report of the QPP. The employees pay a contribution rate which is equal to the contribution rate of the employees. This tax finances a pension plan that protects the contributor and his family against the loss of income due to retirement, disability and death.

Workers' Compensation Premiums[19]

Employers pay the provincial workers compensation premiums to finance the workers compensation board of the province in which their employees work. The workers compensation systems are based on industry classifications with different collective liability assessment and varying degrees of firm-level experience rating, which means

[17] http://www.servicecanada.gc.ca/eng/ei/menu/eihome.shtml
[18] http://www.rhdcc-hrsdc.gc.ca/eng/isp/cpp/cpptoc.shtml and http://www.rrq.gouv.qc.ca/en/programmes/regime_rentes/
[19] http://www.csst.qc.ca/portail/en/ and http://www.wsib.on.ca/wsib/wsibsite.nsf/public/home_e

that the premium rates paid by employers vary according to the risk workers incur of work injuries.[20]

Health and Education[21]

This payroll taxes is levied on employers in order to finance nominally at least the health care and post-secondary education systems in the four provinces which use this payroll tax, namely Quebec, Ontario, Manitoba and Newfoundland and Labrador. The level of this tax is set by the government in the budget.

Labour Standards[22]

This payroll tax is only levied in Quebec, and is used to finance the commission of labour standards which promotes fair and balanced labour relations between employers and employees. The level of this tax is set by the government of Quebec in the budget.

Quebec Parental Insurance Plan[23]

This payroll tax is only levied in Quebec, and is used to finance the QPIP plan which gives benefits to an employee who takes a maternity, paternity, adoption or parental leave. The level of this tax is set by the government of Quebec. its implementation was accompanied by a drop in the EI rate in Québec as this replaced the EI maternity benefits

Employer training tax[24]

The employer training tax is only levied by the government of Quebec on employers who neglect to provide training opportunities for their workers, which must exceed 1% of the total payroll of the employees in order to avoid the tax. The government uses this tax as an incentive to encourage employers to invest in the training of their employees. Employers with payroll in Quebec of less than $1 million are not subject to the employer training tax.

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[20] Bédard (1998, 19).
[21] http://www.revenu.gouv.qc.ca/eng/entreprise/retenues/cotisations/sante.asp and http://www.rev.gov.on.ca/english/guides/eht/2436.html
[22] http://www.revenu.gouv.qc.ca/fr/entreprise/retenues/cotisations/finance.asp
[23] http://www.revenu.gouv.qc.ca/eng/entreprise/retenues/cotisations/rqap_employeur.asp
[24] http://www.formulaire.gouv.qc.ca/cgi/affiche_doc.cgi?dossier=1087&table=0

Table 2 provides a summary of the seven different payroll taxes used in Canada.[25]

Table 2

Payroll Taxes in Canada				
Type of Tax	**Government Authority**	**Contributor**	**Rate (%) 2007 QC**	**Rate (%) 2007 ON**
Unemployment Insurance(UI)	Federal Government (1940)	58% Employers and 42% Employees	2.04	2,52
Canada/Quebec Pension Plan (C/QPP)	Federal and Quebec (1966)	50% Employers and 50% Employees	4,95	4,95
Workers Compensation (WC ou CSST)	All Provinces (1910)	100% Employers	2,24	2,26
Health-Education Payroll Taxes (H/E)	Quebec (1970), Manitoba (1982), Newfoudland (1990), Ontario (1990)	100% Employers	4,26	1,95
Labour Standards (CNT)	Quebec (1979)	100% Employers	0,08	0,00
Quebec Parental Insurance Plan (QPIP)	Quebec (2006)	58% Employers and 42% Employees	0,583	0,00
Employer Training Tax	Quebec (1995)	100% Employers	1,00	0,00

Source: Bédard, M. (1998), "A Primer on Payroll Taxes in Canada", Applied Research Branch Strategic Policy Human Resources Development Canada, R-98-7E, p10.

In this section, we have examined the institutional background of payroll taxation in Canada, this allowed us to distinguish the seven different payroll taxes and see which taxes were general payroll taxes or firm-specific taxes. Moreover, this section also discussed how different levels of government set the rates of taxes and the different purposes for which these taxes are collected.

2.2 The data

The main purpose of this paper is to estimate the incidence of payroll taxation on wages. Thus, in order to measure this incidence we must find data on wages, the dependant variable in the wage equation. Four different sources of data were examined in order to use the best data set available to measure the incidence of payroll taxation in Canada. The

[25] Bédard (1998, 10).

first potential source was the monthly average of the weekly salary for workers by provinces and industrial sectors. The second source was the annual earnings for workers by provinces, age, sex and education. The third potential source was the hourly wage earned by workers, by province and industrial sectors. Finally the chosen source for the dependant variables was the negotiated rate of wage growth for large collective agreements, which counted more than 500 employees. This source of data was preferred to the three other potential sources because this source covers a large time span of 29 years and has observations on the entire population of interest. Moreover, industries were classified with a standardized code and the results obtained with this data could be compared to the results obtained in Vaillancourt and Marceau (1990) for Québec for the 1975-1984 period.

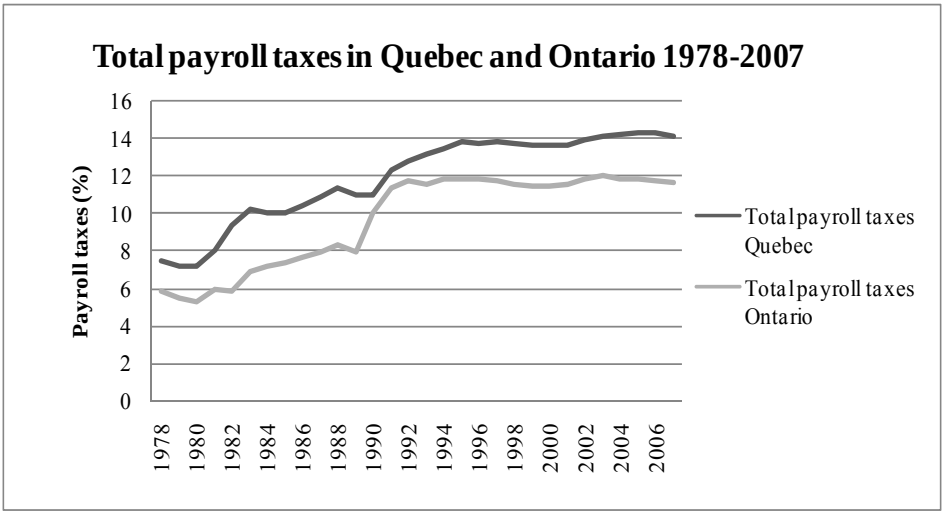
The data consist of all collective agreements with more than 500 employees, which were signed in Quebec or Ontario during the period of 1985 to 2007, which is the period following the data used in Vaillancourt and Marceau (1990). The data set contains the entire population of collective agreements with more than 500 employees for the period of 1985 to 2007. The fact that we have data on the population rather than a sample drawn from the population allows us to avoid the issues due to non random sampling, missing data and selection problem.

The data on the collective agreements were collected by Human Resources and Skills Development Canada. The data on the UI, CPP, HE, CNT and QPIP were collected from published sources.[26] The workers compensation premiums of Quebec and Ontario were provided by the CSST and WSIB, where the former is the workers compensation board of Quebec and the latter is the workers compensation board of Ontario. These premiums were defined for narrow industrial groupings, whose definition had changed for some industries during the period analysed. Discussions with the CSST and WSIB permitted the aggregation of the six digits industrial grouping, in order to be able to match these groupings with the three digits grouping of the wage variable. For further information on the data provided by the CSST and WSIB, please see appendix 1.

[26] Treff and Perry (1985-2007).

The data on the collective agreements were merged together in a single data set, the payroll taxes variables and the economic cycle variables were added later in order to construct an original data set.

Graph 1



In Graph 1 above, we can see the evolution of the total payroll taxes in Quebec and in Ontario for a period of time of 29 years. The total payroll taxes were calculated by the addition of the employer UI, CPP, HE, CNT, QPIP rates and an unweighted mean of the workers compensation premium rate, which means that the total employer payroll taxes may be higher or lower for some industries. This table show an increasing trend in the total employer payroll taxes and in this paper we will exploit this variation in order to measure the incidence of employer payroll taxation on the negotiated wage growth of unionized firm who counted more than 500 employees during this period.

2.3 The model and the variables

The model used in this research is the standard wage equation augmented by the tax variables, which was used in Vaillancourt and Marceau (1990).[27] In this paper we estimate one equation which is identical to the one used in Vaillancourt and Marceau

[27] Vaillancourt and Marceau (1990, 178).

(1990) and a second equation which uses the variable unemployment instead of the variable vacancies. More precisely, the first equation estimated is;

$$W_i = \beta_0 + \beta_1 GPT_i + \beta_2 FSPT_{ji} + \beta_3 CPI_i + \beta_4 COLA + \beta_5 vacancies + \Sigma_{j=6}\, \beta_j Industry_i.$$ (equation 1)

In this equation W is the negotiated rate of growth of base wages, annualized. The tax variable GPT refers to general payroll tax and regroups the sum of the UI, CPP, HE, CNT and QPIP. The second tax variable FSPT refers to firm-specific payroll taxes and is equal to the workers compensation premium, the FSPT varies between provinces, industries and time. The employer training tax was excluded from the analysis conducted in this paper for two main reasons. First, the employer training tax can be avoided by investing 1% of the total payroll in employee training and thus is rarely paid by employers. As an example, 91% of the employers which were subject to this tax in the period of 2000-2003 invested in employees training, 76% of the employers who invested in employee training invested more than 1% while 15% invested less than 1%.[28] Secondly, there is no known Canadian data which contains the employer training tax information for a large enough sample of firm. The second equation that is estimated is;

$$W_i = \beta_0 + \beta_1 GPT_i + \beta_2 FSPT_{ji} + \beta_3 CPI_i + \beta_4 COLA + \beta_5 Unemployment_i + \Sigma_{j=6}\, \beta_j Industry_i.$$ (equation 2)

We will consider two possibilities, namely to express the GPT and the FSPT in their level form or in rate of change. The variable CPI is the average annual inflation observed two quarters before the collective agreement was signed. The variable COLA indicates the presence of an indexation clause in the collective agreement. The variable vacancies is the help-wanted index produced by Statistics Canada, this index measures the change in the demand for labour, is a proxy measure for unmet labour demand and is an indicator of the near-term direction of the labour market.[29] The variable vacancies was only available for the years 1985 to 2003, thus the estimation of equation 1 were restricted to that period in order to have a variable that captures the variation in the short-term demand of labour.

[28] http://emploiquebec.net/publications/pdf/00_fnfmo_rapport20002005.pdf

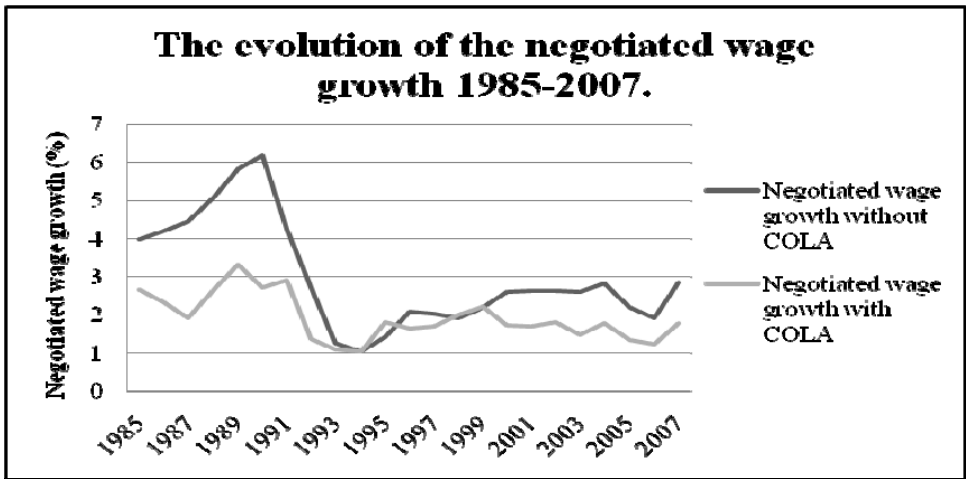
[29] This variable was also adjusted for the change in the size of the labour force (see Appendix). For further information on this variable, can be found on the Statistics Canada web site (CANSIM 277-0002).

The help-wanted index was terminated in April 2003, because many users expressed concern over its performance, especially in light of the growing use of the Internet by employers as a means of posting job openings.[30] Given the fact that the help-wanted index was terminated, the variable unemployment can be use as a proxy for the unmet labour demand instead of the help-wanted index.

The variable unemployment is the average unemployment rate two quarters before the collective agreement. In order to compare the results with those obtained in Vaillancourt and Marceau (1990), the model is also modified to include the square of the variables CPI, vacancies and unemployment. The variable Industry represents the eighteen industrial dichotomous variables. Food and beverages is the reference industry, the excluded industry in the regressions. The industries are: I2: construction; I3: textile, clothing and leather; I4: wood products, paper and printing; I5: petroleum, coal and chemical products; I6: plastics and rubber products; I7: non-metallic mineral products; I8: primary metals; I9: metal products; I10: machinery; I11: computer and electronic; I12: electrical equipment and appliances; I13: transportation equipment; I14: wholesaler and distributors; I15: grocery stores; I16: transports; I17: broadcasting and telecommunications; I18: administrative and support services; I19: accommodation services. Graph 2 compares the evolution of the negotiated wage growth for the collective agreements with cost of living agreements and the collective agreements without cost of living clauses.

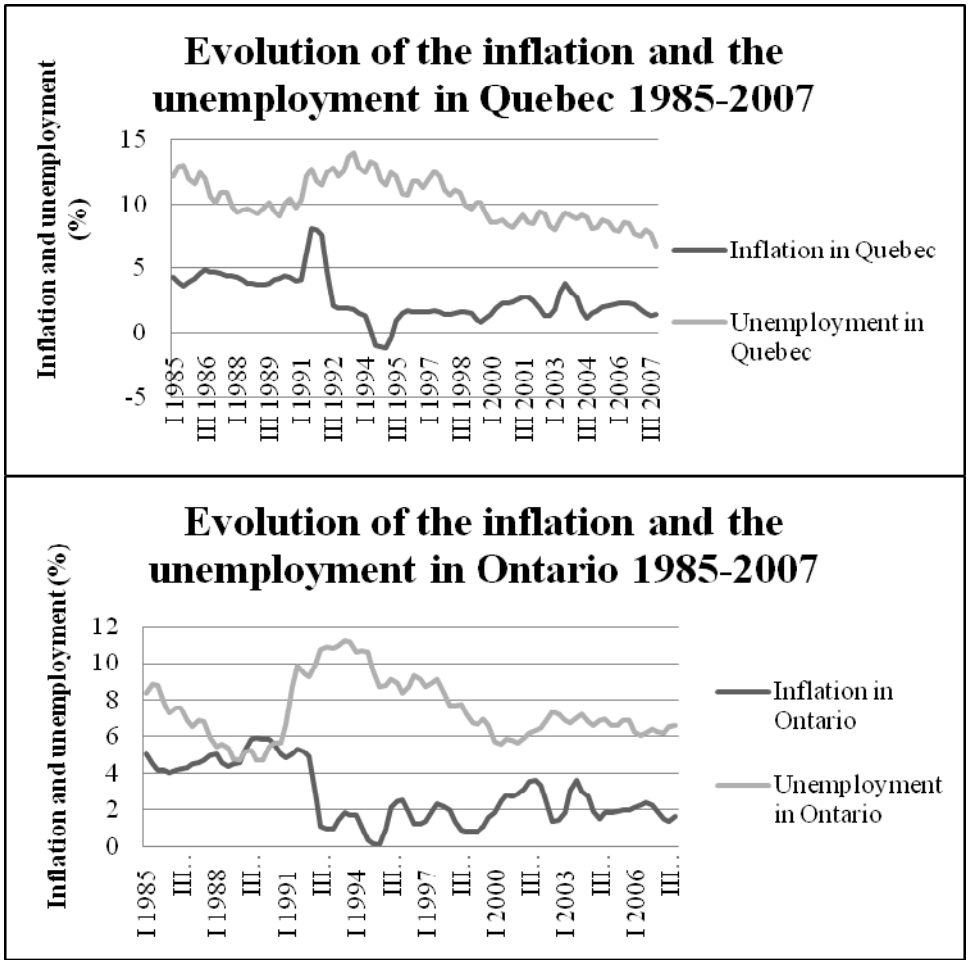
[30] http://www.statcan.gc.ca/cgi- bin/imdb/p2SV.pl?Function=getSurvey&SDDS=2606&lang=en&db =8&dis=2

Graph 2



As we can see the negotiated wage growth is generally higher for the collective agreements without cost of living clauses. Moreover we can see that the 1990s oil price shock which increased inflation also increased the negotiated wage growth. Graph 3 shows the evolution of the inflation and the unemployment in Quebec and Ontario. The inflation and unemployment variables used in this graphic are respectively the average inflation in the consumer price index and the unemployment rate, both 2 quarters before the collective agreement. Looking at Graph 3, one can see that inflation is at its highest peak after the petroleum shock of the beginning of 1990, this shock led to the 1990s Canadian recession. Moreover if we look at Graph 3, we can see that the unemployment started to increase during the beginning of the year 1991 up to the 1992 peak. This is not surprising because the labour market variable such as the unemployment rate, tend to slowly react to economic shocks.

Graph 3[31]



Before we continue to the method and the results section, we will state the predicted relation and the sign of the coefficient of the variables described in this section. The predictions are based on the economic theory of payroll taxation, which was briefly summarized in the section 1. We expect the negotiated rate of growth in wage to: decrease with an increase in general payroll tax (β_1 □ 0); decrease or increase with an increase in firm-specific payroll taxes (β_2 □ 0 or β_2 □ 0); increase with an increase in

[31] The Graphic 3 is based on the following two sources:

1) Statistics Canada (2009), Labour force survey estimates (LFS), by sex and detailed age group, unadjusted for seasonality, monthly (persons unless otherwise noted), 1985-2003, Unemployment rate and the labour force, Quebec and Ontario, Table 282-0001.
2) Statistics Canada (2009), Consumer price index (CPI), 2005 basket, monthly (2002=100 unless otherwise noted), 1985-2007, Quebec and Ontario, Table 326-0020.

prices as measured by the average annual inflation of the two previous quarters (β_3 □ 0); decrease with the presence of a COLA clause ($\beta_4 < 0$); increase with an increase in the index of vacancies (β_5 □ 0); decrease with an increase in the unemployment rate ($\beta_{5'}$ □ 0); vary between industry because of change in the output price or the capital / labour ratio[32](β_{ji} □ 0 or β_{ji} □ 0, j=7,...,24). The goal of this paper is to measure the incidence of an increase in payroll tax on wage growth, thus we are interested in testing the coefficients β_1 and β_2 are different from zero. In other words we want to test H_0: $\beta_1 = 0$, H_1: $\beta_1 \neq 0$, and we also want to test H_0: $\beta_2 = 0$, H_1: $\beta_2 \neq 0$.

Section 3. Method and results.

In section 3, we explained the institutional background of payroll taxation in Canada and we presented the model, the data used and the variables. Thus, it is now the time to turn our attention on the method that is used to measure the incidence of payroll taxation.

3.1 The method

As discussed in the previous section, the negotiated growth in base wage, the dependent variable comes from all collective agreements that were signed between 1985 and 2007. Since we have data on the entire population rather than a sample, the results obtained will be representative of the population of interest and will be free from potential non-random sample problems and selection problems. Moreover, the constructed data set has both a cross section and time series dimensions. Given a province, the cross section dimension exploits the variation among the different collective agreements, while the time series dimensions exploits the variation among the period studied. This has important implications concerning the assumptions needed to measure the incidence of payroll taxation. In particular, this means that we do not have to make the assumption that the incidence is the same among the different collective agreements, as would be the case in a pure time series data set. In other words, the constructed data set is a panel data set of the population of collective agreements which counted more than 500 employees and were signed between the years 1985 to 2007. Because this panel data set follows different collective agreements through time, it is not possible to use the advanced panel data

[32] Vaillancourt et Marceau (1990, 179).

methods, which use fixed effects or random effects. The collective agreements are among the same nineteen industries during the period, but they do not necessarily pertain to the same firm. Given the fact that the data set used in this paper is not following the same units through time and that there is no other Canadian source which follows the same firms for a time period long enough to be analysed statistically, the pooled regression is the correct method. Moreover, the pooled regression method increases the number of observation for our population of interest, which allows us to get more precise estimators and test statistics with more power. A test with more power means that the statistical test will be better at rejecting the null hypothesis, no incidence of payroll taxes, when it is false. This result relies on the assumption that the relationship between the negotiated growth in base wage and at least some of the independent variables remains constant over time.[33]

3.2 The results for Quebec

In this section we will present the results for Quebec's labour market. First we will present and analyse table 3, which summarizes the results obtained when we express the payroll taxes in their level form. Secondly we will present and analyse table 4, which summarize the results obtained when we express the payroll taxes in rate of change.

[33] Wooldridge (2006)

Table 3

The Incidence of payroll taxes, Quebec labour market, 1985-2007.
Negotiated wage growth as the dependent variable. The payroll taxes are expressed in their level form.*

	(1) (1985-2003)	(2) (1985-2003)	(3) (1985-2003)	(4) (1985-2007)	(5) (1985-2007)	(6) (1985-2007)
Constant	3,473 (2,16)	5,552 (3,45)	11,225 (9,53)	11,494 (11,90)	11,224 (10,17)	11,229 (12,43)
General payroll tax	-0,178 (1,61)	-0,248 (2,04)	-0,501 (6,37)	-0,567 (7,57)	-0,515 (7,85)	-0,561 (8,86)
Firm-specific payroll tax	0,011 (0,22)	-0,002 (0,05)	0,054 (1,09)	0,044 (0,90)	0,062 (1,72)	0,054 (1,50)
Inflation in the CPI	0,254 (5,86)	-	0,197 (4,54)	-	0,186 (4,70)	-
Inflation in the CPI^2	-	0,028 (4,51)	-	0,020 (3,65)	-	0,021 (3,92)
Cost of living agreements	-0,710 (4,50)	-0,716 (4,51)	-0,658 (4,12)	-0,658 (4,08)	-0,676 (4,91)	-0,671 (4,83)
Vacancies	0,014 (4,80)	-	-	-	-	-
$Vacancies^2$	-	5,970E-05 (4,82)	-	-	-	-
Unemployment	-	-	-0,206 (5,41)	-	-0,206 (6,25)	-
$Unemployment^2$	-	-	-	-0,011 (6,43)	-	-0,011 (7,60)
Omitted sector is Food and beverages						
Construction	-1,378 (2,07)	-1,160 (1,75)	-1,806 (2,61)	-1,661 (2,44)	-1,540 (2,54)	-1,408 (2,37)
Textile, clothing and leather	-0,839 (2,86)	-0,873 (2,96)	-0,744 (2,53)	-0,772 (2,61)	-0,603 (2,26)	-0,632 (2,35)
Wood products, paper and printing	-0,571 (2,39)	-0,485 (1,99)	-0,670 (2,73)	-0,625 (2,53)	-0,598 (2,64)	-0,557 (2,45)
Petroleum, coal and chemical products	-0,479 (1,35)	-0,534 (1,56)	-0,308 (0,82)	-0,344 (0,92)	-0,055 (0,16)	-0,092 (0,27)

	(1) (1985-2003)	(2) (1985-2003)	(3) (1985-2003)	(4) (1985-2007)	(5) (1985-2007)	(6) (1985-2007)
Plastics and rubber products	-1,311	-1,281	-1,231	-1,225	-1,016	-1,003
	(3,81)	(3,71)	(3,65)	(3,64)	(3,55)	(3,52)
Non-metallic mineral products	-1,020	-0,991	-1,055	-1,043	-0,795	-0,789
	(2,61)	(2,53)	(2,56)	(2,55)	(2,06)	(2,04)
Primary metals	-0,628	-0,578	-0,632	-0,613	-0,291	-0,282
	(2,18)	(2,03)	(2,16)	(2,09)	(1,14)	(1,10)
Metal products	-1,156	-1,113	-1,155	-1,176	-0,710	-0,737
	(1,89)	(1,81)	(1,88)	(1,90)	(1,21)	(1,26)
Machinery	0,044	0,080	-0,019	0,014	-0,115	-0,117
	(0,22)	(0,41)	(0,09)	(0,07)	(0,43)	(0,43)
Computer and electronic	-0,723	-0,855	-0,514	-0,596	-0,374	-0,451
	(1,90)	(2,25)	(1,32)	(1,53)	(1,12)	(1,35)
Electrical equipment and appliances	-0,981	-1,057	-0,796	-0,873	-0,578	-0,646
	(2,07)	(2,24)	(1,75)	(1,94)	(1,56)	(1,76)
Transportation equipment	-0,400	-0,402	-0,362	-0,371	-0,192	-0,200
	(1,53)	(1,54)	(1,35)	(1,38)	(0,79)	(0,83)
Wholesaler and distributors	-0,751	-0,810	-0,661	-0,727	-0,346	-0,397
	(1,97)	(2,13)	(1,71)	(1,87)	(1,06)	(1,21)
Grocery stores	-2,087	-2,074	-1,990	-1,993	-1,811	-1,806
	(3,74)	(3,62)	(3,50)	(3,45)	(3,29)	(3,25)
Transports	-1,115	-1,029	-1,215	-1,150	-1,038	-0,964
	(1,75)	(1,58)	(1,89)	(1,77)	(1,82)	(1,68)
Broadcasting and telecommunications	-0,410	-0,411	-0,275	-0,297	-0,248	-0,274
	(0,70)	(0,70)	(0,47)	(0,50)	(0,57)	(0,63)
Administrative and support services	-0,473	-0,624	-0,296	-0,403	-0,116	-0,210
	(0,69)	(0,91)	(0,46)	(0,63)	(0,21)	(0,38)
Accommodation services	0,376	0,343	0,451	0,400	0,618	0,592
	(1,01)	(0,90)	(1,23)	(1,10)	(2,06)	(1,97)
R^2	0,430	0,420	0,423	0,421	0,409	0,408
N	493	493	493	493	581	581

* t-statistics are in parentheses. Eicker-White robust standard errors were used to correct for heteroskedasticity.

Table 3 above shows the results for the Quebec labour market when the payroll taxes are expressed in their level form. Column (1) shows the results for the estimation of equation 1, while column (2) show the results for the estimation of equation 1 when the variables CPI^2 and $Vacancies^2$ are used instead of CPI and Vacancies. The columns (1) and (2) only use the data from 1985-2003.

Column (3) shows the results for the estimation of equation 2, while column (4) show the results for the estimation of equation 2 when the variables CPI^2 and $Unemployment^2$ are used instead of CPI and $Unemployment^2$. The columns (3) and (4) only use the data for the 1985-2003 period, allowing us to ascertain the impact of this change in variable. Columns (5) and (6) respectively estimate the same equation than the columns (3) and (4) but use the full data set for the 1985-2007 period.

If we first focus our analysis on the coefficient of the payroll tax variable obtained in the six columns, we find that the incidence of general payroll tax is negative as expected and significant in five of the six cases. On the other hand, the incidence of firm-specific payroll tax is positive in five of the six cases, but is not statistically significant. As argued in section 1, the coefficient of firm-specific payroll tax can be positive because of the combined effects on wage of both a downward effect due to the tax rate increase and an upward effect due to the higher risk premiums asked by employees.

Thus estimates for the Quebec labour market show that an increase in general payroll tax is partially transferred to workers through lower wages. In particular, the estimates of the incidence of general payroll taxes on wage are -0.178 and -0.248 when the variable Vacancies is used. These findings suggest that after one year more than 1/4 of a one percentage point increase in general payroll tax is transferred to workers through lower private earnings. Moreover, the estimates of the incidence of general payroll taxes on wages are respectively -0.501, -0.567, -0.515 and -0.561 when the variable Unemployment is used. These findings suggest that after one year more than 1/2 of a one percentage point increase in general payroll tax is transferred to workers.

These findings are pretty similar to those obtained in Holmlund (1983), who used time series regression and found incidence of -0.462 and -0.492 after 1 year. The coefficient of the rate of change in the consumer price index, variable CPI, is positive and significant in all cases.

The coefficient of the short-term demand of labour, variable Vacancies, is positive but not significant while the coefficient of the unemployment variable is negative and significant as expected.

Finally, the industries dichotomous variables are either positive or negative as expected. Since we used pooled regression to measure the incidence of payroll taxes, we needed to test for the presence of heteroskedasticity which is frequently encountered in cross-sectional analysis. The Breusch-Pagan test was conducted and the F-statistics suggested the presence of heteroskedasticity in the model. The White robust standard errors were used to correct for heteroskedasticity and thus obtain valid statistical tests.

In second part of the analysis for the Quebec labour market the payroll taxes were expressed in rate of change to see if this approach could confirm the findings shown in table 3.

Table 4

The Incidence of payroll taxes, Quebec labour market, 1985-2007.
Negociated wage growth as the dependent variable. The payroll taxes are expressed in rate of change.*

	(1) (1985-2003)	(2) (1985-2003)	(3) (1985-2003)	(4) (1985-2007)	(5) (1985-2007)	(6) (1985-2007)
Constant	0,655 (2,37)	1,994 (9,30)	4,261 (7,59)	4,449 (12,65)	3,167 (6,93)	3,687 (12,20)
General payroll tax	0,001 (0,07)	0,002 (0,10)	-0,006 (0,28)	0,019 (0,86)	-0,014 (0,68)	0,011 (0,50)
Firm-specific payroll tax	-0,015 (4,55)	-0,016 (4,93)	-0,004 (1,12)	-0,002 (0,60)	-0,003 (0,98)	-0,002 (0,55)
Inflation in the CPI	0,252 (7,30)	-	0,450 (13,02)	-	0,465 (13,63)	-
Inflation in the CPI^2	-	0,033 (7,43)	-	0,056 (9,59)	-	0,059 (9,93)
Cost of living agreements	-0,670 (4,28)	-0,669 (4,30)	-0,491 (2,98)	-0,452 (2,66)	-0,511 (3,56)	-0,457 (3,11)
Vacancies	0,021 (10,05)	-	-	-	-	-
Vacancies^2	-	9,290E-05 (12,53)	-	-	-	-
Unemployment	-	-	-0,178 (4,11)	-	-0,104 (2,96)	-
Unemployment^2	-	-	-	-0,013 (6,84)	-	-0,010 (5,79)
Omitted sector is Food and beverages						
Construction	-1,250 (4,10)	-1,186 (3,91)	-1,220 (3,12)	-1,127 (2,81)	-0,678 (2,10)	-0,644 (1,99)
Textile, clothing and leather	-0,764 (2,95)	-0,742 (2,85)	-0,857 (2,90)	-0,862 (2,80)	-0,664 (2,35)	-0,655 (2,22)
Wood products, paper and printing	-0,641 (2,88)	-0,557 (2,50)	-0,476 (1,88)	-0,316 (1,19)	-0,331 (1,36)	-0,172 (0,68)
Petroleum, coal and chemical products	-0,334 (0,98)	-0,366 (1,15)	-0,058 (0,15)	-0,002 (0,00)	0,233 (0,61)	0,272 (0,71)

	(1) (1985-2003)	(2) (1985-2003)	(3) (1985-2003)	(4) (1985-2007)	(5) (1985-2007)	(6) (1985-2007)
Plastics and rubber products	-1,474	-1,415	-1,386	-1,295	-1,218	-1,130
	(4,66)	(4,43)	(4,41)	(4,13)	(4,32)	(4,00)
Non-metallic mineral products	-1,171	-1,182	-1,114	-1,113	-0,821	-0,812
	(2,97)	(2,89)	(2,25)	(2,02)	(1,82)	(1,60)
Primary metals	-0,695	-0,613	-0,855	-0,844	-0,443	-0,448
	(2,67)	(2,36)	(2,95)	(2,84)	(1,72)	(1,72)
Metal products	-1,827	-1,729	-1,332	-1,076	-0,698	-0,534
	(3,25)	(3,17)	(1,89)	(1,45)	(1,07)	(0,84)
Machinery	0,095	0,120	-0,306	-0,301	-0,293	-0,372
	(0,47)	(0,60)	(1,35)	(1,25)	(1,05)	(1,09)
Computer and electronic	-0,595	-0,654	-0,723	-0,779	-0,628	-0,686
	(2,19)	(2,47)	(2,35)	(2,45)	(2,05)	(2,15)
Electrical equipment and appliances	-1,217	-1,227	-1,304	-1,395	-1,075	-1,148
	(4,04)	(4,20)	(4,21)	(4,98)	(3,84)	(4,38)
Transportation equipment	-0,555	-0,540	-0,446	-0,402	-0,312	-0,283
	(2,40)	(2,31)	(1,73)	(1,49)	(1,30)	(1,13)
Wholesaler and distributors	-0,665	-0,677	-0,606	-0,653	-0,350	-0,369
	(2,53)	(2,59)	(1,96)	(1,99)	(1,28)	(1,27)
Grocery stores	-1,799	-1,728	-1,513	-1,302	-1,243	-1,007
	(3,30)	(3,02)	(2,78)	(2,27)	(2,31)	(1,79)
Transports	-1,061	-0,999	-0,761	-0,548	-0,495	-0,308
	(1,78)	(1,65)	(1,24)	(0,85)	(0,96)	(0,58)
Broadcasting and telecommunications	-0,902	-0,854	-0,968	-0,937	-0,847	-0,852
	(1,77)	(1,66)	(1,60)	(1,49)	(1,95)	(1,91)
Administrative and support services	-1,232	-1,304	-1,055	-1,171	-0,798	-0,900
	(3,45)	(3,64)	(2,54)	(2,76)	(2,08)	(2,29)
Accommodation services	0,472	0,526	0,465	0,487	0,562	0,607
	(1,27)	(1,37)	(1,13)	(1,14)	(1,58)	(1,64)
R^2	0,501	0,500	0,410	0,376	0,371	0,337
N	459	459	459	459	547	547

* t-statistics are in parentheses. Eicker-White robust standard errors were used to correct for heteroskedasticity.

The table 4 above, shows the results for the Quebec labour market when the payroll taxes are expressed in rate of change. The results in table 4 are organized in the same manner as the results in table 3. Looking at the coefficient of the payroll tax variable obtained in the six columns, we find that the incidence of general payroll tax is negative in four of the six cases and not significant in all of the cases. On the other hand, the incidence of firm-specific payroll tax is negative in all cases and significant when the variable Vacancies is used. The negative incidence of firm-specific payroll tax suggest that the downward effect of an increase of firm-specific tax exceeds the upward effect on wage due to the higher risk premiums asked by employees. On theoretical ground this results is definitely possible as we argued in section 1. However these findings contradict the estimated incidence of firm-specific payroll tax found in Vaillancourt and Marceau (1990). In Vaillancourt and Marceau (1990) the authors found a positive and significant incidence for the firm-specific payroll tax. Since there is no theoretical reason to believe that either the downward effect or upward effect should dominate, it is not possible to reject or accept the finding that firm-specific payroll tax has a positive or negative incidence. Thus, we will keep these results in mind until section 3.3, where we will be able to see if the results for Ontario's labour market confirm the incidence of firm-specific payroll taxes measured with Quebec data only.

The variable CPI has a positive and significant incidence as expected. The variable vacancies which is a proxy for the short-term demand of labour has a positive and significant incidence as expected, while the variable Unemployment has a negative incidence as expected and is significant in all the cases. Finally, the industries dichotomous variables are either positive or negative as we would expect the negotiated wage growth to vary across industries due to their specific labour/capital ratio and other industry specific factors.

3.3 The results for Ontario

In this section we will present the results for Ontario. First we will present and analyse table 5, which summarizes the results obtained when we express the payroll taxes in their

level form. Secondly we will present and analyse table 6, which summarize the results obtained when we express the payroll taxes in rate of change.

Table 5

The Incidence of payroll taxes, Ontario labour market, 1985-2007.
Negotiated wage growth as the dependent variable. The payroll taxes are expressed in their level form.*

	(1) (1985-2003)	(2) (1985-2003)	(3) (1985-2003)	(4) (1985-2007)	(5) (1985-2007)	(6) (1985-2007)
Constant	0,720	2,484	6,744	5,507	7,000	5,651
	(0,81)	(3,10)	(8,97)	(7,71)	(8,71)	(8,06)
General payroll tax	-0,060	-0,086	-0,271	-0,257	-0,296	-0,266
	(0,97)	(1,38)	(5,15)	(4,66)	(5,94)	(5,02)
Firm-specific payroll tax	0,138	0,064	0,284	0,269	0,227	0,204
	(3,63)	(1,73)	(5,44)	(5,56)	(5,76)	(4,79)
Inflation in the CPI	0,261	-	0,174	-	0,164	-
	(3,84)		(2,92)		(2,42)	
Inflation in the CPI^2	-	0,052	-	0,034	-	0,036
		(4,81)		(2,92)		(3,16)
Cost of living agreements	-1,052	-1,063	-0,995	-1,004	-0,902	-0,913
	(5,12)	(5,16)	(5,57)	(4,84)	(4,87)	(4,94)
Vacancies	0,016	-	-	-	-	-
	(6,04)					
$Vacancies^2$	-	5,130E-05	-	-	-	-
		(5,30)				
Unemployment	-	-	-0,317	-	-0,296	-
			(7,98)		(8,10)	
$Unemployment^2$	-	-	-	-0,018	-	-0,017
				(7,56)		(7,49)
Omitted sector is Food and beverages						
Construction	-0,076	0,288	-0,778	-0,714	-0,349	-0,253
	(0,26)	(0,99)	(2,40)	(2,05)	(1,36)	(0,95)
Textile, clothing and leather	0,206	0,186	0,145	0,147	0,224	0,219
	(0,64)	(0,59)	(0,38)	(0,46)	(0,78)	(0,78)
Wood products, paper and printing	0,341	0,218	0,514	0,485	0,465	0,422
	(1,18)	(0,76)	(1,72)	(1,70)	(1,84)	(1,68)

	(1) (1985-2003)	(2) (1985-2003)	(3) (1985-2003)	(4) (1985-2007)	(5) (1985-2007)	(6) (1985-2007)
Petroleum, coal and chemical products	0,566	0,362	0,907	0,869	0,806	0,737
	(2,19)	(1,42)	(2,41)	(3,20)	(3,46)	(3,18)
Plastics and rubber products	-0,030	0,016	-0,200	-0,197	-0,247	-0,243
	(0,09)	(0,04)	(0,57)	(0,56)	(0,79)	(0,77)
Non-metallic mineral products	0,279	0,253	0,207	0,200	0,154	0,136
	(0,80)	(0,74)	(0,50)	(0,56)	(0,47)	(0,41)
Primary metals	-1,851	-1,637	-2,326	-2,271	-1,866	-1,800
	(5,17)	(4,68)	(6,59)	(5,93)	(5,45)	(5,27)
Metal products	-0,024	-0,005	-0,164	-0,161	-0,202	-0,203
	(0,07)	(0,02)	(0,43)	(0,47)	(0,66)	(0,67)
Machinery	-0,515	-0,481	-0,671	-0,655	-0,592	-0,583
	(1,46)	(1,34)	(1,93)	(1,81)	(1,90)	(1,86)
Computer and electronic	0,430	0,316	0,660	0,641	0,670	0,621
	(1,23)	(0,94)	(1,69)	(1,85)	(1,99)	(1,91)
Electrical equipment and appliances	-0,348	-0,448	-0,200	-0,220	-0,278	-0,321
	(0,91)	(1,17)	(0,55)	(0,57)	(0,79)	(0,92)
Transportation equipment	-0,102	-0,012	-0,396	-0,366	-0,305	-0,276
	(0,35)	(0,04)	(1,59)	(1,20)	(1,20)	(1,09)
Wholesaler and distributors	0,362	0,200	0,641	0,614	0,464	0,412
	(1,01)	(0,56)	(1,70)	(1,67)	(1,39)	(1,23)
Grocery stores	0,015	-0,123	0,203	0,181	0,043	0,006
	(0,05)	(0,41)	(0,79)	(0,59)	(0,17)	(0,02)
Transports	-0,835	-0,737	-1,021	-1,008	-0,837	-0,814
	(1,13)	(0,98)	(2,26)	(1,37)	(1,59)	(1,51)
Broadcasting and telecommunications	-0,131	-0,279	0,134	0,115	0,454	0,401
	(0,12)	(0,25)	(0,14)	(0,11)	(0,80)	(0,68)
Administrative and support services	-0,528	-0,381	-0,816	-0,769	-0,319	-0,282
	(1,34)	(1,01)	(1,74)	(2,01)	(0,94)	(0,83)
Accommodation services	0,757	0,675	0,739	0,721	0,771	0,749
	(2,37)	(2,18)	(1,94)	(2,33)	(2,94)	(2,93)
R^2	0,446	0,447	0,460	0,459	0,451	0,450
N	1078	1078	1078	1078	1291	1291

* t-statistics are in parentheses. Eicker-White robust standard errors were used in column (1), (2), (4), (5) and (6)

to correct for heteroskedasticity .

Table 5 above shows the results for the Ontario labour market when the payroll taxes are expressed in their level form. Column (1) shows the results for the estimation of equation 1, while column (2) show the results for the estimation of equation 1 when the variables CPI^2 and $Vacancies^2$ are used instead of CPI and Vacancies. The columns (1) and (2) only use the data from 1985-2003.

Column (3) shows the results for the estimation of equation 2, while column (4) show the results for the estimation of equation 2 when the variables CPI^2 and $Unemployment^2$ are used instead of CPI and $Unemployment^2$. The columns (3) and (4) only use the data from 1985-2003. Moreover, the columns (5) and (6) respectively estimate the same equation than the columns (3) and (4) but use the data from 1985-2007.

If we first focus our analysis on the coefficient of the payroll tax variable obtained in the six columns, we find that the incidence of general payroll tax is negative all cases, as expected, and significant in four cases. On the other hand, the incidence of firm-specific payroll tax is positive in all cases and statistically significant in five cases, which confirms the findings obtained by Marceau and Vaillancourt (1990). Thus the estimates for Ontario show that an increase in general payroll tax is partially transferred to workers through lower wages. Since the estimates of the incidence of general payroll tax are not significant when we use the variable Vacancies, we will focus our attention on the results of the columns (3) to (6), which show the results when we use the variable Unemployment instead of Vacancies. These results show that the incidence of a one percentage point increase in the general payroll tax has an incidence of -0.271, -0.257, -0.296 and -0.266, depending on the equation and the period used. These results point out to a reduction in wages of approximately one 1/4 of the percentage point increase in general payroll tax. The incidence of general payroll tax is slightly lower in Ontario which suggests that it would be harder for Ontarian employers to recoup the cost of payroll taxes by lowering the wage of their employees.

The coefficient of the rate of change in the consumer price index, variable CPI, is positive and significant in all cases. The coefficient of the short-term demand of labour, the variable Vacancies, is positive and significant in all cases. The variable Unemployment is negative as expected and significant in all cases. Finally, the industries dichotomous variables are either positive or negative as expected.

Table 6

The Incidence of payroll taxes, Ontario labour market, 1985-2007.
Negociated wage growth as the dependent variable. The payroll taxes are expressed in rate of change.*

	(1) (1985-2003)	(2) (1985-2003)	(3) (1985-2003)	(4) (1985-2007)	(5) (1985-2007)	(6) (1985-2007)
Constant	0,232 (0,83)	1,575 (6,29)	3,204 (6,57)	2,858 (9,26)	2,654 (6,94)	2,615 (11,43)
General payroll tax	-0,002 (0,24)	-0,005 (0,53)	-0,008 (0,71)	-0,009 (0,81)	-0,010 (0,93)	-0,011 (1,00)
Firm-specific payroll tax	-0,017 (4,01)	-0,017 (4,19)	-0,005 (1,12)	-0,004 (1,03)	-0,005 (1,13)	-0,004 (0,98)
Inflation in the CPI	0,337 (5,34)	-	0,54 (10,67)	-	0,578 (13,31)	-
Inflation in the CPI^2	-	0,063 (7,02)	-	0,089 (12,92)	-	0,093 (15,92)
Cost of living agreements	-0,984 (4,58)	-1,006 (4,68)	-0,878 (3,95)	-0,910 (4,11)	-0,785 (3,98)	-0,828 (4,23)
Vacancies	0,018 (7,76)	-	-	-	-	-
$Vacancies^2$	-	6,380E-05 (7,28)	-	-	-	-
Unemployment	-	-	-0,219 (5,20)	-	-0,175 (4,84)	-
$Unemployment^2$	-	-	-	-0,012 (5,40)	-	-0,010 (5,30)
Omitted sector is Food and beverages						
Construction	0,570 (2,18)	0,568 (2,18)	0,623 (2,37)	0,610 (2,32)	0,719 (3,48)	0,689 (3,35)
Textile, clothing and leather	0,188 (0,60)	0,142 (0,46)	0,269 (0,90)	0,215 (0,73)	0,334 (1,30)	0,249 (1,00)

	(1) (1985-2003)	(2) (1985-2003)	(3) (1985-2003)	(4) (1985-2007)	(5) (1985-2007)	(6) (1985-2007)
Wood products, paper and printing	0,068 (0,23)	0,032 (0,11)	0,204 (0,70)	0,156 (0,54)	0,226 (0,91)	0,162 (0,66)
Petroleum, coal and chemical products	0,336 (1,20)	0,296 (1,06)	0,249 (0,96)	0,237 (0,93)	0,268 (1,26)	0,246 (1,18)
Plastics and rubber products	0,260 (0,66)	0,262 (0,66)	0,118 (0,30)	0,118 (0,30)	-0,024 (0,07)	-0,027 (0,08)
Non-metallic mineral products	0,215 (0,58)	0,196 (0,53)	0,157 (0,42)	0,139 (0,37)	0,076 (0,22)	0,039 (0,11)
Primary metals	-1,562 (4,41)	-1,511 (-4,28)	-1,668 (4,76)	-1,606 (4,61)	-1,406 (4,38)	-1,358 (4,27)
Metal products	-0,061 (0,16)	-0,037 (0,10)	-0,195 (0,54)	-0,171 (0,47)	-0,235 (0,72)	-0,229 (0,71)
Machinery	-0,467 (1,28)	-0,459 (1,21)	-0,497 (1,39)	-0,482 (1,30)	-0,467 (1,49)	-0,478 (1,47)
Computer and electronic	0,177 (0,47)	0,184 (0,51)	0,229 (0,63)	0,244 (0,70)	0,319 (0,94)	0,300 (0,93)
Electrical equipment and appliances	-0,708 (1,83)	-0,704 (1,81)	-0,751 (1,94)	-0,732 (1,87)	-0,814 (2,34)	-0,801 (2,28)
Transportation equipment	-0,021 (0,07)	0,001 (0,00)	-0,133 (0,44)	-0,090 (0,30)	-0,171 (0,67)	-0,137 (0,53)
Wholesaler and distributors	0,046 (0,12)	0,009 (0,02)	0,078 (0,21)	0,052 (0,14)	-0,036 (0,11)	-0,070 (0,21)
Grocery stores	0,071 (0,22)	0,036 (0,11)	0,051 (0,16)	0,016 (0,05)	-0,102 (0,40)	-0,142 (0,55)
Transports	-0,531 (0,64)	-0,573 (0,68)	-0,610 (0,70)	-0,602 (0,68)	-0,593 (0,96)	-0,564 (0,91)
Broadcasting and telecommunications	-0,759 (0,79)	-0,655 (0,63)	-0,889 (0,91)	-0,769 (0,73)	-0,346 (0,63)	-0,251 (0,44)
Administrative and support services	-0,598 (1,51)	-0,477 (1,25)	-0,835 (2,07)	-0,685 (1,77)	-0,341 (0,94)	-0,232 (0,66)
Accommodation services	0,635	0,610	0,654	0,609	0,724	0,667

	(1,91)	(1,87)	(2,07)	(1,99)	(2,79)	(2,67)
R^2	0,455	0,457	0,432	0,438	0,418	0,428
N	992	992	992	992	1205	1205

* t-statistics are in parentheses. Eicker-White robust standard errors were used to correct for heteroskedasticity.

Table 6 above, shows the results for the Ontario labour market when the payroll taxes are expressed in rate of change. The results in table 6 are organized in the same manner as the results in table 5. Looking at the coefficient of the payroll tax variable obtained in the six columns, we find that the incidence of general payroll tax is negative and not significant in all of the cases. On the other hand, the incidence of firm-specific payroll tax is negative in all cases and significant when the variable Vacancies is used. The negative incidence of firm-specific payroll tax suggest that the downward effect of an increase of firm-specific tax exceeds the upward effect on wage due to the higher risk premiums asked by employees. The variable CPI has a positive and significant incidence as expected. The variable vacancies which is a proxy for the short-term demand of labour has a positive and significant incidence as expected, while the variable Unemployment has a negative incidence as expected and is significant in all the cases. Finally, the industries dichotomous variables are either positive or negative as we would expect the negotiated wage growth to vary across industries. Thus the findings for the labour market of Ontario are similar to the findings of the labour market of Quebec. However we obtained different signs for the incidence of firm-specific payroll tax, a positive sign when the tax variables are expressed in level form or a negative sign when the tax variable are expressed in rate of change. Thus, we conducted the Davidson-MacKinnon test to see if the tax variable should be expressed in their level form or in rate of change. The basic idea of this test is that if we have the best specification of a model, the fitted values from another model should be insignificant. The results of this test for Ontario indicate that the payroll tax variables should be expressed in level form because this gives a model than is a better specification of the relations in the data. However, the results of this test for Quebec reject both models, thus there is no clear winner. Moreover since the variable Unemployment has a more significant effect on wage than the variable Vacancies when we express the tax variable in level form, we find that based on our data, the best model to predict the incidence a payroll tax increase is equation 2. Thus if we look at the columns (5) and (6) of the table 3 and table 5, we find that after one year, a

one percentage point increase in general payroll tax reduces wages growth by 1/2 of a percentage point in Quebec and 1/4 of a point in Ontario.

Conclusion

In this paper we constructed an original data set of the population of all the collective agreements which covered more than 500 employees and were signed in Quebec or Ontario for the period of 1985-2007. This data set allowed us to use pooled regression in order to measure the incidence of payroll taxation in Canada. Two alternative models of the incidence of an increase in payroll tax were used: one model separates the general from specific tax and express the tax variables in their level form and second model separates the general from specific tax but express the tax variables in rate of change. We used the Davidson-MacKinnon test to see which model was a better specification of the relations in the data and we found that the tax variables should be expressed in level form. The results show that that after one year, a one percentage point increase in general payroll tax reduces wages growth by 1/2 of a percentage point in Quebec and 1/4 of a point in Ontario.[34] The estimations are similar to other estimations of the short-term incidence of general payroll tax found in the literature. Moreover, the results show that firm-specific payroll tax have a positive but not significant impact on wages growth, which suggests that the upward pressure due to the need of a risk premium exceed the downward pressure on wage due to the firm-specific tax increase. These results suggest that in the short-term, one year, an increase in general payroll tax has a negative impact on wage growth and since this impact is less than the amount of the tax these results also suggest a negative impact on employment.

Thus the results point out to the existence of a trade off between private earnings and social benefits financed with payroll taxes. For future studies it would be interesting to use panel-structured data to measure the incidence of payroll taxes to fully exploit the variation in time and among the collective agreement.

[34] We find similar results when the tax variables are lagged two years instead of one year, and for that reason we only report the impact of an increase in payroll tax after one year.

Appendix Tables A1 to A5

Appendix 1

Variables definition and sources		
Variables	Definition	Source
W	The negotiated grown in base wage	Human Resources and Skills Development Canada (Contact: Sylvie Gratton)
GPT (level)	The sum of the general payroll taxes = UI+CPP+HE+CNT (level)	Finances of the Nation - (1985-2007)
FSPT (level)	The sum of the firm-specific payroll taxes = WC (level)	CSST (Contact: Robert Gagné)
APT (level)	The aggregate payroll taxes = GPT+FSPT (level)	Idem GPT and FSPT.
GPT (rate of change)	The sum of the general payroll taxes = UI+CPP+HE+CNT (rate of change)	Finances of the Nation - (1985-2007)
FSPT (rate of change)	The sum of the firm-specific payroll taxes = WC (rate of change)	CSST (Contact: Robert Gagné)
APT (rate of change)	The aggregate payroll taxes = GPT+FSPT (rate of change)	Idem GPT and FSPT.
CPI	The average annualized inflation two quarters before the collective agreement	Statistics Canada web site (CANSIM 326-0020).
COLA	Dichotomous that = 1 if there is a Cost of living agreement clause in the collective agreement and = 0 otherwise.	Idem W
Vancacies	An Index than serves as a proxy of the short-term demand of labour X (Labour force current year/Labour force in 1985).	Statistics Canada web site (CANSIM 277-0002 and 282-0001).
Unemployment	The average unemployment rate two quarters before the collective agreement	Statistics Canada web site (CANSIM 282-0001).
CPI^2	CPI^2 = CPI^2	Idem CPI
$Vacancies^2$	$Vacancies^2$ = Vacancies^2	Idem Vacancies

Unemployment^2	Unemployment^2 = CPI^2	Idem Unemployment

I2	Dichotomous variable that = 1 if the collective agreement comes from the construction industry and = 0 otherwise. Food and beverages is the reference industry.	Idem W
I3	Dichotomous variable that = 1 if the collective agreement comes from the textile, clothing and leather industry and = 0 otherwise.	Idem W
I4	Dichotomous variable that = 1 if the collective agreement comes from the wood products, paper and printing industry and = 0 otherwise.	Idem W
I5	Dichotomous variable that = 1 if the collective agreement comes from the petroleum, coal and chemical products industry and = 0 otherwise.	Idem W
I6	Dichotomous variable that = 1 if the collective agreement comes from the plastics and rubber products industry and = 0 otherwise.	Idem W
I7	Dichotomous variable that = 1 if the collective agreement comes from the non-metallic mineral products industry and = 0 otherwise.	Idem W
I8	Dichotomous variable that = 1 if the collective agreement comes from the textile, primary metals industry and = 0 otherwise.	Idem W
I9	Dichotomous variable that = 1 if the collective agreement comes from the metal products industry and = 0 otherwise.	Idem W
I10	Dichotomous variable that = 1 if the collective agreement comes from the machinery industry and = 0 otherwise.	Idem W
I11	Dichotomous variable that = 1 if the collective agreement comes from the computer and electronic industry and = 0 otherwise.	Idem W
I12	Dichotomous variable that = 1 if the collective agreement comes from the electrical equipment and appliances industry and = 0 otherwise.	Idem W
I13	Dichotomous variable that = 1 if the collective agreement comes from the transportation equipment industry and = 0 otherwise.	Idem W
I14	Dichotomous variable that = 1 if the collective agreement comes from the wholesaler and distributors industry and = 0 otherwise.	Idem W
I15	Dichotomous variable that = 1 if the collective agreement comes from the grocery stores industry and = 0 otherwise.	Idem W
I16	Dichotomous variable that = 1 if the collective agreement comes from the transports industry and = 0 otherwise.	Idem W
I17	Dichotomous variable that = 1 if the collective agreement comes from the textile, clothing and leather industry and = 0 otherwise.	Idem W
I18	Dichotomous variable that = 1 if the collective agreement comes from the broadcasting and telecommunications industry and = 0 otherwise.	Idem W
I19	Dichotomous vaiable that = 1 if the collective agreement comes from the accommodation services industry and = 0 otherwise.	Idem W

Appendix 2

Summary Statistics of the non dichotomous variable (Quebec)					
Variables	Obs	Mean	Std. Dev.	Min	Max
W	632	2,80	1,70	-2,20	11,50
GPT(level)	581	12,61	1,45	10,05	14,33
FSPT(level)	581	5,08	4,37	0,27	26,69
GPT(rate of change)	550	2,06	3,44	-2,82	12,86
FSPT(rate of change)	550	4,17	18,36	-44,89	91,14
CPI	632	2,82	1,68	-1,20	8,14
Vancacies	544	111,44	33,83	72,20	184,50
Unemployment	632	10,74	1,73	6,73	14,05
CPI^2	632	10,7899	11,63	0,06	66,26
$Vacancies^2$	544	13561,72	8587,45	5212,41	34041,17
$Unemployment^2$	632	118,3015	37,29	45,29	197,4

Summary Statistics of the non dichotomous variable (Ontario)					
Variables	Obs	Mean	Std. Dev.	Min	Max
W	1349	2,87	2,09	-7,10	13,80
GPT(level)	1291	10,44	1,78	7,40	12,03
FSPT(level)	1291	4,92	2,58	0,27	10,90
GPT(rate of change)	1205	2,51	6,48	-4,33	26,54
FSPT(rate of change)	1205	1,02	11,68	-76,05	86,27
CPI	1349	3,00	1,63	0,12	5,91
Vancacies	1136	109,89	43,41	60,31	195,35
Unemployment	1349	7,39	1,72	4,72	11,22
CPI^2	1349	11,62	10,52	0,01	34,93
$Vacancies^2$	1136	13958,41	10723,22	3637,51	38161,51
$Unemployment^2$	1349	57,57	27,43	22,28	125,89

Appendix 3

Davidson-Mackinnon test against Nonnenested Alternatives.*

Quebec

yhat $_{1(\text{rate of change}),\ 1(\text{level})}$	(4,10)	(9,16)	No winner

Ontario

yhat $_{1(\text{rate of change}),\ 1(\text{level})}$	(1,67)	(9,69)	Tax variable should be expressed in level form.

*t-statisticsare in parentheses.

Appendix 4

Summary statistics of the firm-specific payroll tax in Quebec				
Industries	Number of collective agreements	Mean	Min	Max
Food and beverages	65	6,35	3,77	9,52
Construction	24	18,45	7,83	28,16
Textile, clothing and leather	66	3,41	1,00	5,58
Wood products, paper and printing	103	8,46	6,55	11,27
Petroleum, coal and chemical products	23	1,97	1,20	3,66
Plastics and rubber products	27	4,08	2,49	5,64
Non-metallic mineral products	12	5,68	2,98	7,51
Primary metals	67	4,55	3,07	9,51
Metal products	7	3,65	2,43	4,66
Machinery	2	5,76	4,39	7,63
Computer and electronic	27	0,89	0,35	1,16
Electrical equipment and appliances	23	0,89	0,35	1,16
Transportation equipment	65	3,46	1,56	6,66
Wholesaler and distributors	29	2,53	1,27	3,56
Grocery stores	11	2,53	1,27	3,56
Transports	13	12,32	6,01	17,20
Broadcasting and telecommunications	20	0,66	0,22	1,51
Administrative and support services	27	0,55	0,27	0,70
Accomodation services	21	2,90	1,00	4,02
Total *	632	5,04	0,22	28,16

*Unweighted mean of the firm-specific payroll taxes.

Appendix 5

Summary statistics of the firm-specific payroll tax in Ontario				
Industries	Number of collective agreements	Mean	Min	Max
Food and beverages	116	3,87	2,83	5,31
Construction	377	7,89	5,82	10,90
Textile, clothing and leather	26	4,10	2,05	6,09
Wood products, paper and printing	65	2,27	1,42	3,26
Petroleum, coal and chemical products	37	1,40	1,02	2,12
Plastics and rubber products	40	4,26	3,34	5,57
Non-metallic mineral products	24	3,30	2,06	5,37
Primary metals	61	5,81	3,81	8,22
Metal products	31	3,87	3,13	4,65
Machinery	38	3,99	2,39	6,86
Computer and electronic	29	1,61	0,30	4,30
Electrical equipment and appliances	44	4,56	2,42	8,31
Transportation equipment	224	4,56	2,42	8,31
Wholesaler and distributors	31	2,01	1,44	3,27
Grocery stores	123	2,02	1,29	3,27
Transports	25	5,47	4,26	6,49
Broadcasting and telecommunications	6	0,68	0,27	1,32
Administrative and support services	20	3,80	2,15	6,13
Accomodation services	32	3,09	2,26	4,26
Total *	1349	3,56	0,27	3,56

*Unweighted mean of the firm-specific payroll taxes.

Appendix 6

As discussed in section 1.1, the benefit linkage of a payroll tax can have an important impact on the incidence of an increase in payroll tax. Thus in this appendix we show how the results change when we distinguish the general payroll tax with benefits from the general payroll tax without benefits.[35] Since the definition of a general payroll tax with benefits depends on the extent to which the benefits bought by the tax are valued by the workers, in columns (1) and (2), we respectively offer two definitions of general payroll tax with benefits.

In column (1);

General payroll tax with benefits = Canadian Pension Plan (Quebec Pension Plan).

General payroll tax without benefits = Employment Insurance + the Health and Education (Health Services Fund) + Quebec Parental Insurance Plan + Labour standard commission.

Firm-specific payroll tax = Workers compensation premium.

In column (2);

General payroll tax with benefits = Canadian Pension Plan (Quebec Pension Plan) + Quebec Parental Insurance Plan + Employment Insurance.

General payroll tax without benefits = Health and Education (Health Services Fund) + Labour standard commission.

Firm-specific payroll tax = Workers compensation premium.

[35] This appendix was inspired by a comment made by Nicolas Marceau, professor in Economic at the Université du Québec à Montréal.

The Incidence of payroll taxes, 1985-2007.

Negociated wage growth as the dependent variable.	Quebec (1)	Quebec (2)	Ontario (1)	Ontario (2)
Constant	11,136	10,074	6,884	8,410
	(12,09)	(10,85)	(9,52)	(7,52)
General payroll tax with benefits	-0,393	-0,804	-0,202	-0,510
	(5,76)	(5,10)	(3,32)	(3,85)
General payroll tax without benefits	-0,772	0,079	-0,506	-0,162
	(6,67)	(0,22)	(6,28)	(1,08)
Firm-specific payroll tax	0,048	0,030	0,209	0,140
	(1,36)	(0,83)	(4,80)	(3,26)
Inflation in the CPI	0,142	0,168	0,084	0,081
	(3,62)	(4,08)	(1,21)	(1,23)
Cost of living agreements	-0,690	-0,698	-0,908	-0,356
	(5,03)	(5,05)	(4,85)	(8,46)
Unemployment	-0,149	-0,230	-0,248	-0,938
	(3,17)	(6,94)	(5,86)	(5,09)
Omitted sector is Food and beverages				
Construction	-1,358	-1,091	-0,290	0,014
	(2,29)	(1,88)	(1,13)	(0,05)
Textile, clothing and leather	-0,620	-0,758	0,200	0,173
	(2,34)	(2,83)	(0,69)	(0,60)
Wood products, paper and printing	-0,553	-0,611	0,411	0,292
	(2,54)	(2,85)	(1,56)	(1,14)
Petroleum, coal and chemical products	-0,137	-0,196	0,792	0,594
	(0,41)	(0,58)	(3,18)	(2,53)
Plastics and rubber products	-1,016	-1,091	-0,220	-0,167
	(3,45)	(3,73)	(0,69)	(0,54)
Non-metallic mineral products	-0,737	-0,790	0,139	0,138
	(2,07)	(2,20)	(0,42)	(0,43)
Primary metals	-0,256	-0,340	-1,818	-1,662
	(1,01)	(1,33)	(5,34)	(4,94)

	Quebec (1)	Quebec (2)	Ontario (1)	Ontario (2)
Metal products	-0,772	-0,760	-0,192	-0,215
	(1,33)	(1,22)	(0,62)	(0,71)
Machinery	-0,042	-0,125	-0,563	-0,561
	(0,14)	(0,64)	(1,81)	(1,84)
Computer and electronic	-0,464	-0,582	0,675	0,451
	(1,38)	(1,74)	(1,95)	(1,32)
Electrical equipment and appliances	-0,633	-0,731	-0,291	-0,383
	(1,71)	(1,93)	(0,82)	(1,12)
Transportation equipment	-0,207	-0,282	-0,284	-0,201
	(0,86)	(1,19)	(1,11)	(0,80)
Wholesaler and distributors	-0,372	-0,508	0,424	0,296
	(1,16)	(1,56)	(1,25)	(0,89)
Grocery stores	-1,821	-1,922	-0,014	-0,121
	(3,39)	(3,75)	(0,06)	(0,47)
Transports	-1,027	-0,950	-0,820	-0,666
	(1,84)	(1,68)	(1,56)	(1,28)
Broadcasting and telecommunications	-0,333	-0,394	0,421	0,252
	(0,77)	(0,90)	(0,72)	(0,42)
Administrative and support services	-0,188	-0,310	-0,244	-0,192
	(0,34)	(0,53)	(0,75)	(0,57)
Accommodation services	0,596	0,503	0,732	0,699
	(1,96)	(1,65)	(2,80)	(2,65)
R^2	0,428	0,426	0,459	0,457
N	581	581	1291	1291

* t-statistics are in parentheses. Eicker-White robust standard errors were used to correct for heteroskedasticity.

The variables Inflation, cost of living agreements and unemployment have the expected sign and are significant. The general payroll taxes with benefits have a negative and significant effect in all cases. On the other hand, the general payroll taxes without benefits only have a negative and significant effect on wage growth when the general taxes are defined as in column (1). Looking at the column (1) and (2) for Quebec and Ontario, one can see that the impact on wage growth is higher when the Employment Insurance and the Quebec Parental Insurance Plan are included in the definition of general payroll tax with benefits. This indicates that the Employment Insurance payroll tax could be easier to shift to workers through lower wages than the Canadian/Quebec Pension Plan payroll tax.

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